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OFFICE OF ANALYSIS, RESEARCH, AND TECHNOLOGY

Integrated Vehicle-Based Safety Systems Initiative

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Webinar Transcript

Presenters

- Chris Flanigan, Senior Transportation Specialist, FMCSA Office of Analysis, Research, and Technology (ART)

Speakers (optional)

- Kirse Kelly, Web Conference Coordinator, FMCSA, Office of Analysis, Research and Technology

Description:

The goal of the Integrated Vehicle-Based Safety Systems (IVBSS) initiative is to demonstrate technologies needed to equip both light vehicles and heavy trucks with advanced driver assistance systems designed to help drivers avoid the most common types of deadly crashes: forward collision, lane change/merge, and road departure. Its purpose is to develop information on how best to communicate warnings from an integrated system covering multiple hazards to the driver. To this end, objective tests and criteria for performance of systems that simultaneously address the three crash modes have been developed. A field test of an integrated system in ten heavy trucks will soon begin. The test is being done to determine both the safety benefits of the system and driver behavior/acceptance. In this webinar, Chris Flanigan of the ART Technology Division will give an overview of the heavy truck portion of the IVBSS program.

PRESENTATION—INTEGRATED VEHICLE-BASED SAFETY SYSTEMS INITIATIVE

PRESENTATION TITLE SLIDE: INTEGRATED VEHICLE-BASED SAFETY SYSTEMS INITIATIVE

Marla (Operator):

Welcome and thank you for standing by. At this time all participants are in a listen-only mode. Today’s conference is being recorded. If you have any objections you may disconnect at this time. And now I’d like to now turn the call over to the web conference coordinator, Kirse Kelly. Ma’am, you may begin.

Kirse Kelly (Web Conference Coordinator, FMCSA Office of Analysis, Research, and Technology):

Thank you, Operator. Thanks to all of you who are participating in our Webinar today on the Integrated Vehicle-Based Safety Systems initiative which is part of the series put on by the office of Analysis, Research and Technology. Time permitting, all questions will be answered at the end of the call. You can submit questions also in that Q and A box at the lower left side of your screen and at the end of the call you’ll be able to both submit the questions online and ask them over the phone. Please note—you are going to be given an opportunity to download a copy of the presentation at the end of the webinar, and if you have to leave early, you can still return to this website at a later time and slides will be available for you to download.

We’re asked to tell members of the trade or local media participating in today’s call to contact our office of communications at 202-366-9999 at the end of the webinar. Now let me go ahead and turn you over to Chris Flanigan of the FMCSA Technology Division.

Chris Flanigan (Senior Transportation Specialist, FMCSA ART):

Thank you, Kirse. Today I’m going to be giving an overview of the department’s Integrated Vehicle-Based Safety Systems Initiative or, as we call it, “IVBSS.” My name is Chris Flanigan, and I’m with the Office of Analysis, Research and Technology here at FMCSA.

SLIDE 2: WHAT IS THE IVBSS PROGRAM?

What is the IVBSS program? Essentially what it is, is that it’s a DOT effort, but it’s led by the University of Michigan Transportation Research Institute, or UMTRI, as we call them. They lead the cooperative agreement with us on this. Within DOT, the main program is led by the National Highway Traffic Safety Administration, or NHTSA. As was mentioned, the heavy truck platform portion of this Initiative is being led by FMCSA.

The goal, the overall goal of the total program, is to develop an integrated crash warning system in both light vehicles and heavy trucks to estimate safety benefits and the driver acceptance of these systems.

The program spans 54 months and it's a two-phase effort, and right now the funding is at about $32 million—25 million of that is from the US DOT and 7.2 million comes from a cost sharing with the partners in the program.

SLIDE 3: IVBSS PHASE I AND II

As I mentioned, the program is divided into two phases: years one and two. I'll go through the steps that were involved. First we had to identify the crash problems. We came up with crash problems that are rear end, lane change merge crashes, and road departure. These account for 3.6 million crashes per year in the country. Of these 3.6 million, 26,500 of them result in one or more fatalities. This is 3 quarters of all fatal crashes.

Once we had identified the crash problem, we moved on to develop functional requirements for a system. Essentially, what should the system do for the driver? What types of warnings should it give? How does it work?

The next step was to create system performance guidelines. Such as, when it's operating, how should it perform? How soon should it provide warnings; which warnings should take precedence, and so on.

And then finally, in Phase II the final step was to develop and to conduct verification tests.

Now these consisted of two types of tests. The first were on a test track, where we looked at, "Does it meet the specific functionality and system requirements in specific scenarios?" We developed scenarios in the first part of the work to simulate different situations where drivers could be in a situation that would result in a rear-end/lane change merger road departure crash, and we developed specific scenarios that could be conducted on a test track to determine whether the system met those requirements.

The second was an on road verification test where we actually took the prototype vehicle and took it out on the roads of Michigan, about a 300-mile loop, and determined how it performed in the real world. We completed this phase at the beginning of this year, and all the tests were passed by the heavy truck platform—and the life vehicle platform, for that matter, and have moved on to Phase II. Phase II will be done in years three and four of the project and, generally, it's consisted of first building vehicle fleets and then verifying their performance to determine whether the new fleets actually perform the way the prototype did and then to conduct an extended pilot test with one of those vehicles, one of those trucks that had been—had the integrated system installed on it.

The main purpose for this is to determine—or to get the bugs out essentially, to run the vehicle for awhile, to determine whether any problems exist in any phase of the field operational test plan.

And then the next and final step would be to conduct a field operational test. We can do that on 10 trucks over a 10 month period.

SLIDE 4: IVBSS SUBSYSTEMS

As I mentioned, we're addressing three separate crash modes and the subsystems that we're going to integrate in this IVBSS initiative are:

- Forward Crash Warning—this is to address rear end crashes;
- Lateral drift warning—this addresses a lane or road departure crash; and then
- Lane change merge warning—where you get a warning in the event of a lane change crash.

SLIDE 5: IVBSS PARTNERSHIP

This next slide shows the structure of the IVBSS team. As I mentioned, it's a DOT initiative led by NHTSA and with support by FMCSA. There's also been support throughout the program from the VOLPE Center and the National Institute for Standards and Technology. Below that you'll see UMTRI, they are the contract lead on this. They oversee the entire program—both light and heavy vehicle platforms. Below them, in the center, you see Takata. Some of you may know Takata—they started out as Assistware, then changed to Cognix, and now have been purchased by Takata. They are the sensor system developer for the project. I'm going to stick to the heavy truck side here. If you go to the right, you'll see that Eaton is the heavy truck lead. They are in charge of the overall system development. International is the OEM supplier for the fleet test. Conway is the complete provider, and Battelle has provided general support for the project throughout.

SLIDE 6: HEAVY TRUCK PLATFORM

Let me talk specifically about the heavy truck platform.

SLIDE 7: OVERVIEW

An overview—as I mentioned, the goal of the program is to design, develop, verify and then implement in heavy trucks an integrated crash warning system that looks at rear end—that addresses rear end crashes, lane departure crashes and lane change merge crashes. It must appear to the drivers as a single system. I didn't want—we want this to appear as if it was installed by an Original Equipment Manufacturer (OEM) and the driver cannot tell that it's three systems that are integrated, but one system that addresses all three crash modes, and it's done with a Driver Vehicle Interface (DVI) that provides warnings for all of these types of crash modes.

SLIDE 8: SCOPE OF IVBSS REQUIREMENTS

The scope of the IVBSS requirements:

- It has to be an autonomous system independent of the driver.
- There's no active vehicle control. These are just warnings to the driver. There's no—the vehicle does not take control. There's no braking, for instance, that would be activated by the system. It's just simply a crash-avoidance system that creates a warning for the driver in the event of an imminent collision or problem.
- And technologies must be available for the field operational test. We didn't want to develop any new systems for this. We needed to use the available radar and vision sensors that are available on the market now.

SLIDE 9: SYSTEMS ENGINEERING

Systems engineering. I'm going to talk a little bit about these four elements here. First I'll talk about—give a description of the sensors, and talk a little bit about why we picked a tractor-only sensor suite. Then I'll talk about each of the subsystems—each of the three subsystems. Then I'll talk about the driver-vehicle interface, and then finally the objective testing that I mentioned previously.

SLIDE 10: HEAVY TRUCK SENSOR SUITE

This diagram shows the sensor suite that is on the heavy truck from above. It shows the coverage of these sensors. You can see the yellow area shows the rear radar sensors. These are Eaton VORAD back spotters that detect vehicles along the side and rear of the vehicle. In the green there is a side radar sensor. These are MA/COM radar sensors. They detect vehicles—objects or vehicles directly adjacent to the tractor. The dark blue area is a forward radar sensor; this is for the forward collision warning system. And in the light blue you can see the coverage of a short range vision sensor. This is used for lane tracking and so the system knows where the lane markings are on the road.

SLIDE 11: LCM CONCEPT OF OPERATION

I'm going to talk about each of the subsystems a little bit more in depth. On the lane change merge concept of operation is that where the system provides a side object presence indicator to the driver and warnings of safe—rather, unsafe maneuvers. It does this through a directional side visual display and directional auditory display as well. That's where the system actually, if a problem is occurring or an imminent collision is on the right, then the sound comes—the warning alert comes from the right in the cab so that the driver has a sense of where that warning, actually, where the problem actually is.

And this is consistent with the lane departure warning display, as well. There's also a need there for a directional auditory display and side visual display. And as I mentioned in the sensor suite, this is done through a combination of MA/COM radars and Eaton VORAD backspotter radars.

SLIDE 12: LCM GENERAL OPERATION

This next slide shows the typical readings that we give for the lane change merge and the general operation of it, and I'm going to go through each of the condition codes and talk about what the driver is going to see and hear.

The first condition code, LCM0, is where there is no vehicle detected adjacent to the subject vehicle. The side marker has nothing illuminated and the forward display is blank, and, of course, there's no auditory display.

LCM1 is when there is an adjacent vehicle detected. The vehicle has not made any attempt to change lanes, but there is a vehicle detected, so then a yellow light comes on in the bottom of the side display, but there's still no visual display on the forward display and again, no auditory display for this mode.

LCM2—whenever there's an adjacent vehicle detected and the corresponding turn signal is active, but a lane change mover is not detected, a red light comes on to warn the driver—to say "Hey, you're signaling that you're going to make a lane change and you should not do that." There is no visual display on the forward display at that point, and again no auditory display.

Now in the case where there is an adjacent vehicle detected and a lane change maneuver is detected, whether the turn signal is on or off, the warnings will be a red light similar to that—or the same as that as an LCM2, but the forward display will display a picture that shows a side collision alert and then, depending on which side the lane change is occurring on—the problem is (on)—the adjacent vehicle is on, you get a right or left channel side collision warning from the audio part of the display.

SLIDE 13: LDW CONCEPT OF OPERATION

The lane departure warning concept of operation. The idea there is to track lane boundaries and, as I mentioned when I looked at the sensor suite, it does that with forward vision sensors that detect and track lane position. They do this by measuring the vehicle position and a lateral velocity relative to the lane; and this is to assess the threat of a lateral departure to warn the driver when they're about to depart the lane.

SLIDE 14: LDW GENERAL OPERATION

This is the general operation of the DVI for the lane departure warning. The first condition is normal driving and good boundaries. If the vehicle is maintaining a lane position and the forward vision sensors can track both lanes, the only indicator you'll get of that—that the system is available—is if you look on the forward display in the lower left hand side, there is a circle that is split in half. When both halves of that circle are dark, it shows that the lane markers are detected on both sides of the vehicle.

Next condition is in a normal driving scenario but the missing—there's a left boundary that's missing. And again, if you look in the lower left-hand side of the forward display, you'll see that there is half of that circle is not filled in, only the right half is blackened which shows that there is a no lane boundary detected on the left side.

Now, when we go to the next condition, you'll see that this is showing a lane departure in the absence of an object in the adjacent region, or typically a run-off-the-road scenario. If the turn signal is off and there is a dashed or solid line boundary, and the system can detect that the vehicle is leaving the lane that it was in and because the signal—the turn signal—is not on, it's assumed that the driver is not intentionally leaving the lane. At that point, there would be a directional lane excursion warning. That is again directional. If you're going off to the right of the road, then it would be to the right side of the cab and the sound is what's called an auditory icon. For a run off the road or departure into a clear space it would sound similar to that of a rumble strip so that the driver has some sort of idea of what exactly is happening intuitively.

The next one is a departure into an occupied space. Now this is exactly the same as a lane change merge warning into an occupied space. I mentioned in an LCM that regardless of whether the turn signal is on or off the same warning will sound, but if a lane departure with an object detected in an adjacent region is detected, then this warning will sound. The side indicator light, the red light, will come on and again, there will be a directional side collision warning, but it's not the same as the "rumble strip" sound. It's a beeping type sound that's a little more urgent sounding.

SLIDE 15: FCW CONCEPT OF OPERATION

The forward collision warning concept of operation. This system essentially includes two systems in one. It has both a headway warning system and an imminent collision detection system. The first essentially provides drivers with a graded cautionary warning when the headway time to a forward object drops below four established threshold levels and the second system provides a collision warning when there's a significant risk of a collision detected.

SLIDE 16: FCW WARNING LOGIC DETECTION & HEADWAY ALERTS

The warning logic for the headway alerts. For the first condition FCW1: This is a situation where the system has just picked up a forward object. The system has detected a forward object with the forward-looking radar. There's no auditory display, but the forward display does show that there is an object detected.

The forward object—I'm sorry, FCW2—is when the subject vehicle gets within three seconds of headway and are either opening or closing the distance between the vehicle and the forward vehicle, and then you'll notice in the lower left-hand side of the forward display there's a yellow light that the first segment has illuminated on.

The next step of the threshold is that there's a forward object detected within two seconds of headway, and again, either opening or closing the distance between the two. Once that two-second headway is detected, what you're going to see is that the forward display shows the two segments of yellow cautionary lights illuminated, the picture that shows two seconds of headway and the truck's a little closer to the forward vehicle, and now an auditory display comes into play. If at this point the subject vehicle is opening the distance, is increasing the distance between the forward vehicle, then there's no sound, but if the subject vehicle is closing the distance, then there is a short alert, the short beep.

And the next step in the threshold is that when the forward object is within one second of headway and again either opening or closing the distance. You'll notice on the forward display that there are three yellow lights that are illuminated on the left-hand side. The picture shows the subject vehicle a little closer to the forward vehicle with the one second indicated there and if the subject vehicle opens the distance, there will be no sound, no auditory display, but if the vehicle is closing still—getting closer to the forward vehicle—there will be a double alert.

And a note that headway alerts are only provided when the subject vehicle speed is greater than 10 miles an hour.

SLIDE 17: FCW WARNING LOGIC COLLISION ALERTS

The second system in the forward collision warning logic, or imminent collision.

FCW5—that code responds to when a forward object is within 0.5, or half a second headway and closing. In this case the forward display changes. The yellow lights on the side are not illuminated anymore; the three red lights along the top are illuminated and the words "Collision alert" appear, and the auditory display has a repeating alert. It's an urgent sounding alert to warn the driver that there's a problem: there's an imminent collision.

Second are that the six—I should say FCW6—is the exact same forward display and auditory display, but it doesn't have to do with headway. It shows that the subject vehicle is approaching a slow moving vehicle and it alerts the driver to the relative speed of the subject vehicle—to the vehicle it's approaching.

And then the final alert is for a stationary vehicle object alert. If the driver of the subject vehicle is approaching a stopped vehicle, it gets the same type of a forward display with the red lights along the top and collision alert, but then a different type of an auditory display. It's a double alert, a double type of a beep to alert them to the stopped vehicle.

SLIDE 18: ARBITRATION

Those are the subsystems and, because the system is integrated, there has to be a way to arbitrate these signals. That means that when you look at two different warnings, if a vehicle—or the subject vehicle—is in a situation where there are more than one threat, say, for example, approaching a stopped or slowing vehicle and then trying to avoid that vehicle by going into an occupied adjacent lane, the system has to know which is the most important signal to warn; and this and many other different issues with multiple threat scenarios are—the way to create a system that addresses these is to use it—is to develop a rule-based approach. What this does is it rates the message priorities and those rules are developed based on those ratings. Which is the more problematic situation to address. There are more complex rules and exceptions that need to be taken into account and put into the algorithms. These include the vehicle kinematics—is the a vehicle on a straight road, a curved road, the speed of the vehicle, the yaw rate—things of that nature.

Cues to driver alertness—is the driver maintaining his lane? Is the driver maintaining his speed? Is he speeding up, slowing down? This is a cue to show that the driver may not be as alert as he could be. And indications of driver awareness to the threat—for instance, is the turn signal on? Does the driver know that he’s going off the road? How about braking when a forward object is detected? Those are the types of things that show that the driver is aware.

Crash risks. Like I said—which crashes take precedence in the scheme of things. Whenever there’s a multiple crash risk, you have to determine which one poses the biggest threat, and then provide the warning for that.

SLIDE 19: DVI CONCEPT OF OPERATION

The driver-vehicle interface concept of operation. First of all, the focus is on supporting timely and appropriate response from the driver. In many of these scenarios there is a minimal time to address crash scenarios and obviously the response needs to be quick and, of course, appropriate.

The integration should support the development of an accurate and functional mental model of IVBSS. In a word, it should make sense. I mentioned that the lane drift—lane departure off the road that sounds like a rumble strip—that makes sense, and it’s to the right. If you’re going off the road to the right, the sound is to the right, so it makes sense to the driver. Lane change into an occupied right lane—the right audio is going to sound and give the driver an idea of where the problem is so that the quickest reaction can happen.

We also want to support the driver in avoiding errors, distraction, confusion and information overload. The bottom line is do no harm with these systems. If the driver becomes more confused in a multiple threat situation, it’s only going to make matters worse.

And the last is to understand that heavy truck drivers are significantly different than passenger car drivers. They have formal training and the system should be developed to be intuitive, but could assume a higher level of driver skills and awareness of the system than that of the light vehicle platform.

SLIDE 20: DEVELOPMENT PROCESS – HEAVY TRUCK PLATFORM

This is sort of takes you through the entire development process for the heavy truck platform and, starting on the left, as I mentioned, we identified—started by identifying the crash problems which—the three scenarios: rear end, lane change merge and run-off-the-road—and then looked at crash scenarios that illustrated these types of crash mode situations.

We also looked, as you’ll see below, at “Operational (do-not-warn) scenarios.” These were developed to address false alerts and nuisance alerts. For instance, a false alert could be that of an overhead object, or a nuisance alert could be defined as closing on a lead vehicle that’s leading its lane or an intentional road departure with a signal.

These types of situations need to be minimized because, as I mentioned, what we're looking at—one of the big aspects of the final product will be driver acceptance. Do drivers accept us? And if there are a lot of false alerts, then it's likely that drivers are not going to want to have this type of a system in their vehicle.

Once these crash scenarios were developed, we moved on to functional requirements. That was a document that showed the required functionality. When do we want the system on, when do we want it off and a number of other aspects; that's the functionality of the system.

We then moved on to performance guidelines. These are the quantitative and measurable performance metrics. This is what you can take out onto a track and determine whether the system actually performs the way it's supposed to perform.

As I mentioned before, we have objective test procedures to determine whether these performance guidelines were met, we worked to create procedures and test scenarios where we could take the vehicle onto a test track, run it through a scenario—in our case 10 different times—and determine whether the system actually met the criteria that we established. The criteria that we set for passing that, by the way—for the objective test procedures—was to pass eight out of 10 of those objective tests for each of the scenarios.

And once the vehicle is released for the FOT we went to verification testing, which is "on-the-road" testing. As I mentioned, we had a loop in Michigan where the vehicle is taken out into the real world and determined whether it actually does perform the way that we—under the criteria that we had set.

You'll see there's a box down in the lower right there that indicates that this document—or these documents—are available publicly. They all are actually available and at the end we'll give you a website where you can download any of them. But then we moved on to the FOT build once this initial development process was done.

SLIDE 21: OBJECTIVE TESTING TRUCK SETUP

In the objective testing I just wanted to give you a sense of where the sensors and cameras were located. Starting from the upper left and you could see there's the—on the bumper there where the forward-looking AC20 radars are located for forward crash warning. Moving over you can see the rear looking-MA/COM radars. Those are for the side object detection.

In the front there's a forward-looking camera. That's for the lane change—or the lane detection system and the back spotter radars that I mentioned which are—that go along the side of the trailer and to the rear of the Eaton backspotters are in the lower right or two right photos.

SLIDE 22: TRACK TESTS

I mentioned that we developed specific track tests to determine whether the vehicles meet the functional requirements and system performance. I'm not going to go through each one of these but you can get a flavor of—the three subsystems are tested specifically with tests like 2.1 where there is a vehicle approaching: the subject vehicle is approaching a forward vehicle at constant speed and closing rate. Does it warn at that—does the headway warning work; does the forward collision warning work; the imminent collision work?

Next, in 3.1, you can see lane change. The verification test for 3.1 was if you have a vehicle of constant speed occupying a lane to the right of the subject vehicle, will it warn when that subject vehicle veers into the lane of—the occupied lane? And then for road departure, we looked at three different scenarios there, the three different scenarios there shown where the vehicle is departing towards the opposing traffic lane and departing towards a shoulder and then departure on a clear shoulder on a curve.

The tests that I don't have depicted here are the multiple threat scenarios. I mentioned perhaps approaching a stopped vehicle and then avoiding that vehicle by going into an occupied lane; a no-warn scenario where perhaps a vehicle is leaving the road with a turn signal—intentionally leaving the road and trying to limit the false alerts.

SLIDE 23: PHASE II – EARLY TASKS

As I mentioned, we successfully ended Phase I by passing all the verification tests and meeting those criteria, and we kicked off Phase II in June. Some of the early tasks that we tackled in Phase II are: first of all, to complete the final vehicle integration design; and we wanted to launch the vehicle fleet builds. We're going to have 10 trucks that need to be equipped with these systems and tested in the real world.

We also have to integrate the final FOT data acquisition system to gather the data for the field operational tests. And then it's an ongoing effort to tune the system to reduce false alerts. That's an iterative effort—the changes that could be made need to be maximized before we begin the field operational test. A bullet I don't have on here is something I mentioned earlier—the next step would be to run an extended pilot test where we can essentially get the bugs out and determine whether the vehicles are—determine whether the systems are performing properly, and the drivers are happy with the systems, and no problems that we hadn't anticipated come up.

SLIDE 24: HEAVY TRUCK (HT) FOT SCOPE

After the extended pilot test, we'll move into the heavy truck FOT. Basically, this testing is going to occur over a 10-month period. The first month-and-a-half or two months will be baseline data collection with the system turned off, and the remainder will be with the system on. The volume of data we expect to get would represent about eight years of heavy truck driving data. This data will be stored on the heavy truck and will be downloaded at the fleet center and approximately 600 gigabytes of data is expected from this work.

SLIDE 25: FLEET LOCATION

The fleet location. We're running the FOT out of Conway Freight's Romulus, MI terminal. Their runs are over Michigan's lower peninsula, northern Ohio and Indiana, and to Chicago. There's two types of delivery. There's two types of runs: there's the local pickup and delivery, which is 41% limited access highway, and there's also line haul which is 96% limited access highway. So at the end of it, the total exposure for the fleet will be 82% limited access highway and 18% service roads.

The drivers in this test will be ranging in age from 25 to 65, and they will all be male. There are no female drivers at Conway at this point.

SLIDE 26: HEAVY TRUCK FOT DATA

The data that we're going to be collecting in the FOT. First off, the subjective data. We've got questionnaires, focus groups, debriefings. Essentially, this is about driver acceptance. Do drivers like it? What did they like about it? What didn't they like about it? We are maintaining an open line of communication throughout, as well. These subjective data will be formally collected at the end, but during the program we have a direct line to—I should say the drivers have a direct line to the testers and they can ask questions, they can register a complaint, they can talk about a perceived problem with the system and have it addressed immediately.

The other side is objective data. It's going to be collected on a multi-central processing unit data acquisition system that is hopefully unobtrusive. It's mounted in the back of the truck and the side of the truck, and out of the driver's way; and we want to get a full-time data set that describes vehicle performance, which encompasses speed, steering, braking. Driver performance—there's alertness of the driver, the actions of driver. We'll have a video camera on the driver to determine what's going on at any point in time; and vehicle location—what type of road were they on? What were the situation: what was the curvature of the road, and things of that nature. And finally, driving environment—the weather, the traffic, the things that could affect the lane markings—the condition of those, perhaps. We had an issue in the past where in the extended or in the verification tests some of the lines or lane markings were obscured by salt. So we'll know about things of that nature.

SLIDE 27: FMCSA'S ROLE

FMCSA's role—as I said, we're helping to support the heavy truck platform work in this initiative, and our role is overall to assure safety of commercial heavy trucks. We want to encourage deployment of safety equipment that we deem beneficial or is deemed beneficial to heavy truck safety. This is a huge effort and many carriers would like to conduct something like this, but they don't have the time or the funding to do so. So we see our role as, if this system is shown to be beneficial, that we would go out and say just exactly that, and talk about the benefits, and also to provide information to manufacturers who would want to create a system like this themselves. This is not a "be-all end-all" system that we would say has to be like this or nothing else. This is a wealth of information about the development of a system like this.

Second is to assure safety is not adversely affected by overloading heavy truck operators with information. One of the things I recall seeing when systems were first being developed in the early '90s is I noticed there was a system for everything by after-market producers and I often wondered what would happen if a carrier said well, I'd like to get one of each and then ended up overloading the drivers with information. I think that would obviously lead to problems on the road and we obviously don't want that to happen. So, the driver interviews and the focus groups will be key in determining whether this was a problem for them—if it was too much information, or if it was confusing.

The next thing, our role is to assure that IVBSS accounts for the unique requirements of operating heavy trucks. For example, like I say, the headway information is critical for heavy truck drivers because the evasive capabilities are not as great as that of a light vehicle. So warnings should come sooner if possible. Based on that, stopping distance is also much greater than for a light vehicle. So it's a different type of an operating environment, and it needs to be accounted for in the final judgment of this type of a system.

SLIDE 28: PROGRAM STATUS

Program status—as I mentioned, we completed Phase I; the heavy truck systems passed all the verification tests. We had a public meeting on these results last April. There's a website link right below to show you the results from that or to show you the public meeting results.

We kicked off Phase II in June 2008. We are conducting track and on-road tests. Actually, we just completed them yesterday—I believe yesterday we completed the final on-road verification tests. We've already completed the track tests. We plan to start the extended pilot tests next month and the field operational test is scheduled to start in early 2009.

SLIDE 29: CONTACT INFORMATION

Below you'll see, of course, there's my contact information. Feel free to call me at any time if you have any questions or comments. I'll be glad to answer them or, if I can't, I'll point you in the direction of someone who can. At the bottom of the page there is a website which has a compilation of all of the relevant documents and background material for the program for your reading enjoyment. So at any rate, I'll turn it back to Kirse and we can answer any questions you may have.

[43:42]

QUESTIONS AND ANSWERS

Kirse Kelly: We are now open for questions, and if you would like to ask a question, you can submit questions in the Q&A box which is on the lower left side of your screen or, if you want to ask questions over the phone, just press *1 and state your name to the recorded message. When your line is open, Marla our phone operator will announce you by name. So please state your name clearly for proper pronunciation. The questions are going to be answered in the order that they are received. As I mentioned at the beginning of the call, please note that you will be given an opportunity to download a copy of this presentation at the end of the call. If you have to leave early, you can return to this website at a later time and you can then download it. So we'll go ahead and start.

[Unless otherwise noted, all questions asked are typed online and repeated aloud by the web conference host.]

Mark Bauckman: ***Which division of Con-Way? Truckload?***

Chris Flanigan: It's the division of Conway, I'm not sure how they—I mean it's pickup and delivery and line haul. It's the Romulus terminal. And I'm not quite sure how to define which division it is. I could certainly get back to you. I've got your name there.

Ronald Knipling: ***Has there been any consideration of using the system's capabilities to assess the overall quality of a driver's driving, including lane-keeping, headway maintenance, and other aspects of space management?***

Chris Flanigan: I think that's going to be part of the final report. It's focused on the IVBSS system, but as far as having it be used for other activities, I can't say what it will be used for in the future, but I know the final report will certainly take those into account.

Paul Schmitt: ***Are the functional requirement and performance guidelines, test procedures available?***

Chris Flanigan: Yes, they are available on that, the link at the end of the presentation.

Paul Abelson: ***Several suppliers have already announced active forward warning and braking systems for collision avoidance. They act independently of the driver, although drivers can override the systems. Why are these systems not included in the study?***

Chris Flanigan: We determined that the systems should be passive; that there should be no active control by the vehicle. There are a number of other systems we could have included as well—rollover stability, and things of that nature, but we decided not to. This was a test of just crash warning systems with no active control. That's certainly something that could be done in the future, but for the purposes of this study we stuck with just passive systems.

Liz Glooschenko: ***Will the sensors be able to detect lanes if they are concealed by a sheet of ice or snow?***

Chris Flanigan: The answer probably is no. I mean a sheet of ice—that could be a thick ice or thin ice. I'm not sure, but the system was able to detect lanes with some salt debris on the road and I can't say I actually saw the actual tests being done, so I'm not sure about the degree to which it needs to be visible, but yeah, the sensors can detect the lanes but I would say over snow that there's no way it could detect it because it's not visible. Essentially, it has to be visible to the eye.

Kirse Kelly: Marla, are there any questions on the phone at this time?

Operator: Yes ma'am, we do have a question from Virginia Spence. Ma'am, your line is open.

Virginia Spence: Thank you Operator. Hi, Chris. Thanks for your time for the presentation. I was wondering if you could provide any comments on the light duty findings from this study, for the light duty vehicles. Thanks.

Chris Flanigan: I'm sorry, I cannot. I have not had much involvement with that side. I'm present for a lot of the meetings that we've had where both are discussed, but the specific findings of light vehicle, I've not been involved with directly.

Kirse Kelly: Anything else, Marla?

Operator: Ma'am, at this time, no, we don't have any other questions.

Chris Flanigan: And to answer the earlier question of the division on Conway, it's Conway Central—that's the division. Less-than-load.

Glenn Wilson: Was there any human factors analysis performed on the DVI?

Chris Flanigan: Absolutely. A lot of human factors analysis. In fact, I believe there's a document online that documents that. I'm sure there is. The DVI was tested in focus groups to determine things like the warning sounds where they—what types of sounds would be most effective. Which views would be most effective to see—for the driver to see? We had a simulator test of the system, a static simulator to determine how the system would work before we ever put it on a truck. So yes, there's a really detailed description of that work at the website that I have left a link for at the end.

Michael P. Wilson: How will the test drivers be selected?

Chris Flanigan: They volunteer. At Conway—we are coming out of the Romulus terminal in Conway, and drivers who would like to be part of the test are volunteering to do so.

Victor Malchesky: Does the system have the ability to notify the carrier so the carrier knows how frequently and what type of events are occurring? This would allow carriers to address driver behavior since that is at the root of everything.

Chris Flanigan: This system does not, but I mean we would be able to go back and see what the driver was doing at the time that the incident occurred and it certainly could be addressed that way, but this test was not set up to address that type of an issue. It’s to test specifically this integrated system.

Julie Poncy: ***These systems will provide immediate feedback to the driver; however . . . This is actually just a repeat of the last one—It’s “Is the information communicated to the carrier as well?”***

Chris Flanigan: Right. Yes.

Ronald Knipling: ***Provide more information about planned comparisons between the baseline phase of the FOT (when the system is not providing feedback) and the fully operative phase.***

Chris Flanigan: Well, it’s essentially to look at situations where there could have been a warning and there was not; and perhaps when a driver was not aware of a potential crash scenario or a situation that was imminent. It’s looking at the characteristics of the actual driving habits of a driver with and without. So, I don’t know if I could—I mean, the design of the FOT is such that you have that baseline data to look at and to compare how much it helped to have that system in. And, it could maybe hinder it in some situations, but we want to find out about that, and the baseline will show us what that behavior is like without the system active.

Kirse Kelly: Marla, are there any other questions on the phone?

Operator: Ma’am, at this time we do not have any questions.

Thomas Bray: ***Were these systems completely independent of the vehicle or was the J-bus system used?***

Chris Flanigan: The systems are completely independent of the vehicle. Well, the data, the actual data of the vehicle kinematics is being collected, so I don’t know if that’s what you meant or whether the actual data from the systems in the truck were being utilized.

Kirse Kelly: If you want to go further on that question, you could just hit *1—and, Marla, if Thomas comes on, just let us know.

Operator: Thank you.

Brad Heffron: ***As safety professionals we recommend a minimum of 6 seconds following distance interval for large platform trucks. Why are the forward warning systems set for 2 seconds or less?***

Chris Flanigan: Well, the first threshold is three seconds or less, and the system starts to warn at that point when there’s a problem, and I think that it might have been an issue of false alerts because when a—I’ve heard often what that when a driver has created a large gap in between the forward vehicle, then it can be filled by another vehicle—sometimes, obviously in an unsafe manner, by a lighter vehicle. But, nonetheless, I think three seconds was decided as the threshold at which a warning would start to take place. Otherwise, you could run the risk of overloading the driver with information and creating a constant irritant, I guess—for lack of a better term.

Samuel M Mamula: ***Is the system able to detect smaller-than-a-vehicle objects—pedestrians, animals, debris on the road?***

Chris Flanigan: We have tests that detect motorcycles. So yeah, it has the possibility of—yeah, absolutely, animals—depending what size animal you're talking about. I'm sure a deer would be detectable, but we haven't done testing with respect to that. That's something we'll find out in the FOT perhaps.

Kirse Kelly: We have a request to just repeat our media call-in number that members of the trade or local media who are participating in today's call are asked to contact our office of communications and that number is 202-366-9999.

Ronald Knipling: ***Why is speed on curves not a part of the system? Will it be added to the IVBSS suite later?***

Chris Flanigan: It was not included because the speed on the curve was not deemed to be that big of a problem for the drivers. That's—that was the decision. That's actually included on the light vehicle platform but it was determined that it should not be included on the system for the heavy truck platform.

Thomas Bray: ***Is this a follow-up to, or part of the project that field-tested collision warning systems and other systems in a fleet of trucks previous to 2005?***

Chris Flanigan: Well, this is drawing on past research, a lot of past research—the road departure warning system, the ACAS, the advance collision avoidance system test—and there's other research that has actually been drawn upon, but it's not a specific follow-up to that per se.

Kirse Kelly: Do we have any questions on the phone, Marla?

Operator: No, ma'am, we do not.

Kirse Kelly: We have a statement:

Samuel M. Mamula: ***There is lots of information for the driver to process, in addition to speed, rpm, driving the vehicle, and so on—so what has or will be done to evaluate the drivers' ability to process the information provided by the system and react appropriately to it?***

Chris Flanigan: Well, what we have done is the tests, the actual human factors tests—the DVI tests where we did the simulator and looked at what people can process. To evaluate the ability to process the information during the FOT, will be done through questionnaires, a focus group and, like I said, we have an open line of communication with drivers. If they are having a problem, we hope they talk to us about it and, if they're not, we hope to get them in an interview at the end and ask specific questions. We have a rather extensive questionnaire for them to get to the bottom of those types of questions. The other thing would be is if there was—if the drivers were unhappy with the system in general, and maybe did something to disable it. I don't know that that would happen, but if their driving is being hindered, we would hope to find out about it immediately and process that.

Julie Poncy: ***How does the Lane Departure sensor determine items such as highway markings, or surface—grass vs. pavement, and things like that?***

Chris Flanigan: Well, it's a vision sensor that is designed to pick up lane markings. Very simply, it's a video system that can distinguish between pavement and a lane marking. It's not perfect, but you can tell, as I showed with the forward display. When the system actually detects the lanes, you get the full darkened circle, and you know that the system is actually detecting a lane, and if it's not, it will let you know. And if there's no indicator of that, then the system is not active. It's not detecting the lanes.

Richard Lair: ***So far, what was the drivers' reaction to these systems?***

Chris Flanigan: We have not started the field operational tests yet, so the reactions we would get would only be from perhaps some of the drivers who had taken it out for the on-road tests. We haven't really done formal interviews. I know that obviously they've discussed this with the UMTRI team. I don't know of any adverse reactions to it, but there's been some enthusiastic comments from Conway. They like the system for the actual—the safety director is a driver, as well, and he had taken it out and was impressed by its performance. But other than anecdotal stuff like that, I couldn't really give you a distinct picture of what they think.

Julie Poncy: ***Is there a significant difference in the tone of the various different audio—audible warnings?***

Chris Flanigan: Yes, there is. I'll spare you my imitation of them, but the forward collision is sort of an urgent-sounding beeping type noise, and the road departure is a rumble strip, and the lane change merge is another type of beeping. Originally we had the lane change merge as a horn honk—or a similar sound to a horn honk—and in some of the initial on-road testing some of the drivers had said that this might present a problem because if there's a false alert when they're making a lane change where they think the lane is clear, if they were to get that horn honk sound, then that might lead to them losing confidence in their ability to make a safe lane change because they might in the back of their head think that that is a real horn honking and it might degrade their driving confidence. So we changed that. It's more of a beep sound.

Michael P. Wilson: ***Similar to that, where is the display physically located?***

Chris Flanigan: I should have mentioned that. The side detectors with the red and yellow lights are located on the left-hand side of the driver—mounted on the near where the inside where the mirror is—and the forward display is located literally forward on the dashboard right in front of them.

Kirse Kelly: Marla, do we have any questions on the phone?

Operator: Ma'am, we do not have any questions at this time.

Julie Poncy: ***Do the forward clearance sensors integrate with the vehicle to automatically decrease speed, or simply alert the driver?***

Chris Flanigan: There is no active control. There is only a passive warning—or there's only a passive—it's only a passive system. It provides a warning to the driver or, in the case of the forward sensors, it provides object detection where there may not be any kind of an alert to be issued, but it at least shows the presence of a forward vehicle or that one is detected.

Kirse Kelly: We have a statement—

Patrick Case: ***This system was assembled from commercially available components. What is the cost—do you know the cost of the sensors, DVI, and associated installation?***

Chris Flanigan: I don't know the total cost, I must admit. That I would imagine would be something that would be in the final report.

Samuel M. Mamula: ***How critical is proper installation, adjustment, aiming, maintenance of the sensors to make sure the system operates as it is designed to do? How robust are the sensors in regards to damage?***

Chris Flanigan: Well, as I said, these are all commercially available sensors, so they are designed to be operated in this environment. To talk about the first part of your question—it's extremely important that throughout the field operational tests we maintain the vehicles and determine whether the sensors are still aligned, whether they're not obscured by any road debris or whether the system has—to determine whether it's failed in any way. The way that we'll determine this is that the vehicles will have weekly downloads by the team of the data and any problems could be detected then. We're also hoping, as I mentioned, for the driver input—if there's a problem that he sees with perhaps an increase in false alerts or something of that nature, then we could get in there and realign the system and determine—and make sure that the system is properly aligned.

Samuel M. Mamula: ***What about hearing-impaired drivers, or drivers who have partial hearing loss in one ear? Would that negate the "side" warning of the system?***

Chris Flanigan: Well, in this case, you'd still have a visual warning. As far as I know, we don't have any drivers that are hearing impaired. One of the things that the light vehicle side does—the light vehicle platform does—is to have a vibrating alert that will give sort of the right side or the backside of your back a little bit of a vibration to give you that same type of directional awareness of what's going on. That was not done in the heavy truck for the simple reason that this system needed to be an OEM or—it had to appear as an OEM-installed system and we could not do that with the seat as far as I understand with the heavy truck. So that was not included, but I hope that there is a discussion about that in the future because one of the other issues that I had heard come up was about not just hearing impaired drivers, but say, for instance, suppose a driver was in a team with another driver, a tandem-type team where one driver sleeps in the back while the other one drives. The driver in the back might really be annoyed by occasional sounds or alerts going off, and if that could be disabled or switched over to a half-tick or a "vibrational" type warning, then that might be helpful to those types of drivers. So that's something I think needs to be discussed.

Liz Glooschenko: ***Will the sensors continue to operate if they become dirty?***

Chris Flanigan: Well, they could. That's a pretty broad question. I mean—you could get so dirty that they would be obscured and would not operate, and you could get some sort of a mid-level of dirt that would obscure it a little bit and perhaps might cause it to not operate to full capacity. But I think that's a pretty broad question. Yeah, some dirt—it's going to have to be assumed that it's going to be—there will be some dirt on the sensors occasionally, but if it gets to be excessive, then it needs to be cleaned off. And that's what I hope that the team, when they're collecting data and they inspect the systems periodically, would be able to pick something like that up. It will also show up in the data, too. I mean, if there is a situation where no warning is given in the data, when they're looking at each weekly download, they'll be able to determine whether a sensor is properly functioning—whether it has dirt on it or not, or for some other reason. It could just be malfunctioning for some other reason.

Kirse Kelly: Are there any questions on the phone, Marla?

Operator: Ma'am, we do not have any questions.

Kirse Kelly: Okay, so our final question is—

Glenn Wilson: ***Was there any consideration given to haptic feedback?***

Chris Flanigan: I just mentioned that. The reason why we didn't do it was because of the capability of putting that type of a system in a heavy truck seat. We could not do that for this particular setup. So consideration will be—or it will be discussed. I'll put it to you that way.

[1:06:30]

Kirse Kelly: Thank you, everyone, for your participation in today's webinar and we'd like you—to just ask you to fill out our evaluation and let us know your comments about this webinar and suggestions for future webinars. To insert suggestions, you can just type comments in the space at the bottom of that pod on the lower left side and click on the arrow. The comments provided here can be viewed by all other participants in the meeting room. So, if you'd like to remain anonymous, you can click on "**Everyone**" at the bottom and choose "**FMCSA Host**."

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As a reminder, members of the trade or local media who are participating in today's call can contact our Office of Communications at 202-366-9999.

Once again, thank you, everyone, for participating in our webinar, and while our webinars for November are not yet confirmed, we do have some in the planning stages. So please continue to check on the FMCSA ART website to register for future webinars—and that registration usually opens one or two weeks before the webinar. We have one planned in two weeks.

If you're not yet on our mailing list, you can send a request to me—I'll be putting this up on the screen later, but it's Kirse.Kelly@dot.gov. Thank you all very much for participating.

[1:08:31]